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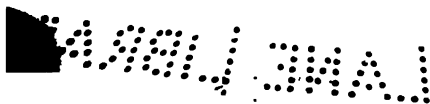
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ON THE INTERNAL USE OF WATER FOR THE SICK, AND ON THIRST.

GENTLEMEN:—It is now thirty-seven years since I entered upon the private practice of our profession, under the auspices of my father, Prof. Chas. D. Meigs. I learned from him, early in my career, that it was rarely wise for the physician to refuse water to a thirsty patient. I soon learned, also, that young children often suffer for the want of water from ignorance on the part of the mother or nurse, from inattention on the part of the physician, or from the direct prohibition, by medical authority, on theoretic or practical grounds, of this simple and necessary aliment. It is more than twenty years since I heard from one of my patients, a tender and truthful woman, the following story. I have often felt my flesh creep as I related its pathetic details. My patient had a friend living near her,—a woman with a family of several children. One of these children, a boy of five or six years old, was seized with acute dysentery. A doctor was sent for. I am pleased to know that he was not a scientific physician, but a doctor who followed one of the miserable isms of the day. He forbade the

mother to give water as drink, lest it might increase the frequency of the intestinal discharges. The child had been sick for several days, and was losing largely, from the alimentary canal, the fluids of the body. He was heated with fever, and was evaporating water at a rapid rate from the skin and lungs. He wanted water. Above all things he wanted water; but the doctor had denied him this boon. My patient was in the sick-room late in the day. The child was begging for water. "Mother, give me some water; give me some water." She dared not. Presently he dragged himself up in his bed, tottered out upon the floor, fell upon his knees, and putting up his poor little hands in prayer, cried, "Mother, give me some water; Mother, give me some water!" She, that unhappy woman, with the strange faith in the physician, which some women have, dared not. That night he died.

You have many of you, I am sure, heard of the famous Madame Roland, of the French revolution. She was one of the most widely known, and one of the finest and noblest women of that dreadful time. Carlyle tells her story in his strange and graphic way. She was tried before the revolutionary court, and the brutal judge of the day, Fouquier-Tinville, and of course condemned to the guillotine. Carlyle describes her at the foot of the scaffold, in such words as these: "Noble white vision, with its high, queenly face, its soft eyes, long black hair falling down to the girdle, and as brave a heart as ever beat in a woman's



bosom ! Like a white Grecian statue, serenely complete in the black wreck of things ;—long memorable.” As she stood at the foot of the guillotine, she turned to the statue of Liberty by the scaffold, and uttered the famous words, “ Oh, Liberty ! Liberty ! how many crimes are committed in thy name ! ” When I think of the many errors which have had their day in the past, in the history of Medicine ; the sanguinary bleedings, the furious purgings, the over-use of mercury, the dangerous administrations of antimony, and the strange refusal to the sick and even dying of water to quench a burning thirst, I am tempted to cry, “ Oh, Medicine ! Medicine ! how many errors are committed in thy name ! ”

As I have passed on through a busy life in the sick-room, this simple matter has become more and more important in my estimation, and I propose, therefore, to devote the lecture of to-day to its consideration. I hope to fix in your minds, thus early in your career, some clear and distinct principles of action in regard to this seemingly simple subject.

There is a curious and active prejudice in the public mind against the free use of water, as a drink, under certain conditions ; and this prejudice sometimes extends to the sick-room, without, perhaps, the knowledge of the physician. Many laboring people fear to use water freely when the body is heated by work. At the very moment when this is fast losing its fluids, during labor in hot weather,

by sweating, and by rapid evaporation from the lungs and skin, the laborer is afraid to drink, lest he may chill, as he says, his stomach, or injure in some mysterious way, his desiccated body. The jockey refuses his panting horse, streaming with sweat, and exhausted by heat, the water absolutely necessary to maintain the due fluidity of the blood and tissues. This latter prejudice is giving way, I am happy to see, under the teaching of the modern veterinary surgeons, who have been instrumental in introducing the practice of watering the horses on our city railroad routes, once or twice on each route, in hot weather. Our public drinking fountains, now placed in various parts of the city, are another proof that a wiser practice in this matter is being developed.

My plan of treating this subject will be the following: I shall first relate to you the history of some cases I have met with, which show that the sick are sometimes deprived of water by the physician on certain practical grounds, and sometimes by inattention on the part of the physician or nurse.

Next, I shall read you passages from the history of persons deprived of water by accident, to show not merely the suffering caused by this loss, but the different morbid conditions determined by it.

Then I shall consider the physiological functions of water in the economy; the amount required for the daily uses of the body; and, what is very important to us, its

office of regulating vital heat by evaporation from the lungs and skin.

And, lastly, I shall seek to establish some fixed rules of practice as to the amount that ought to be furnished to the sick.

I have already related to you one story, which shows that the sick sometimes suffer grievously for the want of this most necessary aliment. I will now cite some other experiences which still further demonstrate this fact.

When I was a boy of twelve years of age, I was sent, with two of my brothers, into the country, to a farm in New Jersey, for the August holidays. We were alone, under the care of the farmer's wife. One of my brothers was seized with a fever, and the neighboring physician was sent for. He ordered some blue pills or calomel, and told us all that the child must have no water, lest it might interfere with the action of the remedy. That hot and fevered body, which was evaporating its water from the lungs and skin at a far more rapid rate than in health, must have no new supplies of fluid lest the pill might be incommoded in its action. The only safe guide as to the amount of drink the patient needed, the thirst, must be rudely set aside. He moaned and cried for water. We were afraid to give it. In two days our mother arrived from home. So soon as she heard the story of the illness, she began to administer draughts of cool water in such quantity as could be taken with ease and satisfaction. The doctor came, and hearing

of her action, was in high dudgeon. "Doctor," she said quietly and politely, "my husband is a physician, and always allows, indeed, directs me, when my children are ill, to give them all the cool water they desire." He left the house in a passion. The next day the patient was removed home, where he recovered without any evil consequences whatever.

On the 3d of September of this year, I was called to see a child, a girl, fourteen weeks old. The mother had passed the early part of the summer at the sea-side, and had removed to the interior of the State, to the mountains. A few days before they were to return to the city, the child was seized with an intestinal catarrh, the result of dentition and heat. A physician was called in, who told the mother to give the baby no water, lest it should increase the diarrhœa. He allowed ice. They travelled on the 2d of September, a hot day, and reached home late in the evening. During the day, the child was restless and uneasy, and cried and fretted a great deal. On the following morning at ten o'clock, when I saw the child, it was pale and rather thin. The night had been very much disturbed. There had been three loose stools and some vomiting. The child had taken a little milk and water, but had always seized ice, when offered, with avidity. The restlessness was remarkable. There was no screaming, but a constant, uneasy whimper, with turning and twisting in the nurse's arms. I asked whether the child was thirsty. The mother did not know, as only ice

had been allowed. A glass of cold water, containing a small teaspoonful of brandy, was brought, and presented to the child. It was seized with the greatest eagerness, and a large portion taken rapidly. In ten minutes the child was fast asleep, and continued to sleep soundly until four o'clock in the afternoon. I regulated the diet, gave a chalk mixture, and ordered all the water the child desired. The diarrhœa continued for a few days and then disappeared.

I have related these cases to show you that the sick are sometimes deprived of water by the order of the physician. I will now cite two which demonstrate that they sometimes suffer in the same way, from ignorance on the part of the mother, and from want of thought and practical insight on the part of the physician.

On the 6th of November, 1863, I was called to see a child, a girl, five months old, who had been brought into the city from the country-seat of the parents, on the 19th October in perfect health. On the 30th October, it was vaccinated by the accoucheur. On the 5th November, six days afterwards, a severe diarrhœa set in, attended by very considerable prostration. On the afternoon of that day the child cried and fretted incessantly, and was very restless. This condition persisted through the night and morning of the next day. The mother, becoming alarmed, asked that I, as the family physician, should see the child. I found it slightly feverish, but not, in appearance, seriously ill. Yet it was still crying a curious, unhappy, complaining cry,

a constant whimper. It had had no sleep and was strangely restless. I could find no evidence of pain, and, knowing how often young children suffer from thirst, asked whether it had had any water. It had not. A glass of fresh, cool water was brought and applied to the lips. A considerable amount was taken in a short time, and soon the cry and restlessness ceased. The child fell asleep and next day was well. This was evidently one of those cases in which the vaccine disease had determined a sudden, watery diarrhœa. The loss of a considerable amount of the water of the body by diarrhœa produced unusual thirst, and this was the cause of all the crying, insomnia, and jactitation. It shows how responsible is the place of the physician. He must stand in the place of speech to the voiceless child, and feel, as well as think for it.

Some years since, in the month of August, I was sent for to see a little girl, eight months old, whose mother had just arrived in town from the country, where she was spending the summer with her family. The child had been attacked four days before, with diarrhœa. The diarrhœa was not severe, but was attended with vomiting. A physician was sent for, who ordered some medicine, and made some change in the food. The child was hand-fed. For two nights and days it had rejected by vomiting most of the food taken. It would drink milk and water with some avidity, and almost instantly reject it. During these two nights and days, the child had been restless and almost without

sleep. There was constant crying, and great restlessness. The crying was incessant, not loud nor angry, nor with the acute sound of pain, but with a wailing note of misery and distress. I saw the child at ten o'clock in the morning. It did not look ill, but was lean-looking, and had slight feverish heat of the skin. The face was distressed, and the little low cry was continuous, and attended with a certain curious restlessness of the body and limbs. The point in the case was to determine the cause of the crying and uneasiness. Was it from pain, and, if so, where was the pain? The abdomen was soft, not tender to the touch. Could it be the early stage of hydrocephalus, as in this disease there is much pain from headache? I thought not from the character of the cry, from the entire absence of drowsiness, and the complete integrity of the intelligence and senses. Was it earache? There was no inflammation about the ear, and no tenderness on pressure or handling. Suddenly I thought of thirst. Have you given it water? No, the mother replied, I never thought of it, and the doctor said nothing about it. A teaspoonful of brandy was added to a glass of cool water, and offered the child. It was seized at once and half the contents swallowed without a pause. The glass was withheld for a few moments, lest the quantity might cause vomiting. The child cried for more, and soon drank the remainder. I ordered four tablespoonfuls of milk and lime water to be given every two hours, and water from time to time. Later in the day, I found that

the child had soon become quiet, and had slept. It had had one loose stool. On the following day, it was better, and on the third day was taken back to the country, with directions to the mother to return gradually to the usual diet. The only medicine given was a chalk mixture. The recovery was rapid. When they returned to town in the fall, the mother said to me: "How odd, was it not, that I had to come all the way to town to learn that my poor little baby was crying with thirst!"

With one more case I shall finish these histories. I relate this one, not that it shows simply the fact of suffering from thirst, though this had some part in the history, but to let you see what curious things occur in practice connected with children. It is thirty years since I attended a stout, healthy boy, fourteen months old, nursed by a vigorous young mother. The child had a violent capillary bronchitis, complicated with intermittent fever. The catarrh was so severe as to cause the respiration to rise to 68 in the minute, and the pulse to 160 for several days. At the end of ten days the bronchitis had greatly diminished. The respiration and pulse had fallen, and the temperature was nearly normal. But, now, when the child ought to have exhibited the signs of convalescence, a new condition set in. He began to cry. He cried almost incessantly. Placing him at the breast would stop the cry for the time, but so soon as he was removed it began again. The crying was violent, obstinate, most distressing, so that the whole

family was in misery about it. What was the pain? Where was it seated? For pain, we all thought it must be. Finally, though there were no signs of irritation about the ears, I concluded that there must be a deep otitis, and so had hot onion poultices, under a cap, applied over both ears. I might as well have put them on the top of the church steeple. Just at this time, when I was at my wit's end, the grandmother of the child came in. She was a wise old lady, who had had ten children of her own. She looked at the child for some time in her wise way, and turning to me, said: "Doctor, that baby wants to lie at the breast." I knew what a strange, intuitive knowledge some of these experienced women attain to, and so told the mother to try it. The child was put to the breast, where he nestled for nearly twenty-four hours. At the end of that time, he was well. Was this thirst? Or was it merely the luxurious rest and comfort which the infant enjoys at the breast? I think it was both.

I pass on to the second division of my subject, the consideration of the morbid conditions determined in the body by the loss of its due supply of liquid. With this view I shall take some sketches from the history of persons deprived, by accident, of water. You must not suppose that I accuse our art of the terrible crime of frequently refusing the use of water to the sick, and so starving people to death; but I am convinced, by personal experience, that this matter is not sufficiently attended to,

at all times, in the sick-room, and I desire to impress you strongly with its importance. If men suffer so dreadfully, fall ill, and die, for the want of water, let us see how they suffer, and how they die, in order to guard ourselves against the risk of increasing the suffering and danger from disease, by a failure on our part, to supply this aliment in sufficient quantity.

I select the history of the famous shipwreck of the French frigate, the *Medusa*, and the story of a party of soldiers who were deprived of water on the arid plains of Texas.

An expedition, consisting of four vessels, sailed from the Isle d'Aix, on the west coast of France, on the 16th of June, 1816, for the French possessions at Senegal, on the west coast of Africa, which had just been restored to France by England, through the treaties of 1814-15. The only vessel of the fleet concerning us, the frigate *Medusa*, carried about 240 souls. The ship ran on a dangerous reef, not very far from her destination, the port of St. Louis, on the 2d of July. They tried to heave the vessel off the reef, but failed, and on the 5th of July it was resolved to abandon her. The chief officers, and some of the crew, took to the boats, four in number, while from 147 to 150 persons, officers, soldiers, and crew, were placed on a large raft which had been constructed, the intention being that the boats should tow the raft to the shore. In the hurry of the embarkation, six casks of wine, and only two of

water were placed on this raft. The only provisions they had were twenty-five pounds of biscuit, and some barrels of flour. The boats towed the raft for a short distance, and then, under the influence of selfish terror, and want of proper discipline, abandoned the raft, and made the best of their way to the shore, where they all arrived in safety.

The raft floated helplessly on the sea for thirteen days. On the second night the soldiers broached one of the wine-casks, and, becoming wild with wine and delirium, attacked the officers, who were collected together in the middle of the raft. A furious hand-to-hand combat took place, and many were killed or thrown into the sea. In the height of this strange delirium the soldiers threw the two casks of water, some of the wine, and the barrels of flour, into the sea. They cast overboard the only woman on the raft, with her husband; the two were rescued, only to undergo the same fate afterwards. On the morning of the third day, only 60 of the 150 persons, remained; of the wine, but two casks had been preserved; on this day they began to devour the dead bodies left upon the raft. As the sun rose on the morning of the fourth day, it shewed the survivors ten or twelve of their companions extended lifeless upon the wreck; their bodies were cast into the sea, except one which was retained to feed those who, as the narrator says, "the day before had clasped his trembling hands, vowing him eternal friendship." The fifth day arrived; only thirty persons remained—of this number but

fifteen seemed likely to survive some days ; the others were covered with wounds, and had almost entirely lost their reason. The fifteen who retained some strength, held council together, and resolved that, to save their own lives, the others must be thrown into the sea ; they were aiding to consume the only drink they had, the small amount of wine remaining,—so they were cast into the sea. Amongst those sacrificed, was the one woman on the raft, who had twice already been rescued from the water, when cast overboard by the mad and infuriated soldiers.

It was about this time that the narrator of the story gives some account of the character of the sufferings they endured : “ A raging thirst, which was redoubled in the daytime, by the beams of a burning sun, consumed us ; it was such, that we eagerly moistened our parched lips with urine, which was cooled in little tin-cups—we put the cup in a place where there was a little water, that it might cool the sooner ; it often happened that these cups were stolen from those who had prepared them—the cup was returned to him to whom it belonged, but not till the liquid it contained was drank.” M. Savigny, a young Swiss surgeon, and one of the narrators, observed that the “ urine of some of us was more agreeable than that of others. There was a passenger who could never prevail on himself to swallow it ; in reality, it had not a disagreeable taste ; but in some of us it became thick and extraordinarily acrid ; it produced an effect truly worthy of remark : namely, that it was

scarcely swallowed when it excited an inclination to urinate anew. We also tried to quench our thirst by drinking sea-water—M. Griffin used it continually; he drank ten or twelve glasses in succession. But all these means failed, or diminished our thirst only to render it more severe a moment afterwards.” They put sea-water into their hats and washed their faces with it at frequent intervals; they moistened their hair with it, and plunged their hands into it; they reserved their small portions of wine in their tin-cups, and sucked it through a quill. This mode of taking it was very beneficial, and quenched the thirst more than when it was all taken off at once. “Three days passed in inexpressible anguish; we despised life to such a degree, that many of us did not fear to bathe in sight of the sharks, many of which swam about the raft; others placed themselves naked in the front of the machine which was still submerged; these means diminished, a little, our burning thirst.”

On the morning of the thirteenth day, a ship appeared—one which had been sent out from St. Louis, to search for them. They were saved. “Let the reader imagine,” says the narrator, “fifteen unfortunate men, almost naked; their bodies and faces disfigured by the scorching beams of the sun; ten of the fifteen were hardly able to move; our limbs were excoriated, our sufferings were deeply imprinted on our features, our eyes were hollow, and almost wild, and our long beards rendered our appearance still more frightful; we were but the shadows of ourselves.”

Thus, of the 147 or 150 persons on the raft, only fifteen were saved, and of this small number, five died after reaching St. Louis. Those who still exist, it is said, were covered with scars, and the cruel suffering which they endured had greatly impaired their constitutions.

I will cite one other history to show the action on the economy of the deprivation of water. This account will give us a better idea of the physiological effects arising from the want of this aliment, than the wreck of the *Medusa*, though it seems to me that even on that dreadful raft, the wild delirium which worked such bloody consequences, was the result, largely, of the want of water, since the survivors appear to have satisfied the cravings of hunger on the dead bodies of their companions. In the account I am about to read, the only want experienced was that of drink. They had plenty of food. There was no exposure to cold or wounds.

You will find the story told in the "American Journal of the Medical Sciences," for April, 1878, at page 404. It is a "brief account of the sufferings of a detachment of United States cavalry, from deprivation of water, during a period of eighty-six hours, while scouting on the 'Llano Estocado,' or Staked Plains, Texas." By J. H. King, M.D., Captain and Assistant Surgeon, U. S. A. The report is not based upon personal experience. The writer was one of the relieving party sent in quest of the lost men. Shortly after meeting the party he noted down the substance of the paper, "which he gleaned while the events were still vividly im-

pressed upon their memories." "It is feared," he says, "that some of the details may, at first sight, appear scarcely worthy of notice; but any particulars concerning human beings deprived of water for such a long period, and under such circumstances, apart from bearing in a measure upon physiological science, are not totally devoid of interest."

For my part, I think they are not only not totally devoid of interest, but that they are very full of interest; since they show in such vivid light the nature of the morbid conditions induced in the body when it fails to receive its due supply of this essential aliment. I never see a dangerous fever case without thinking how important it is that society should have physicians trained in exact knowledge of physiology, as well as of disease. When I stand by the bedside of a severe typhoid fever, and see the patient motionless, insensible, dead to all the usual senses of the living, when I look at his half-closed eyes, his gaping mouth, his dried and fissured tongue, when I brush the unheeded flies from his poor, unconscious face, and when I touch his hot and burning skin, I ask myself, into what lower estate the human body can fall. Not only has the patient lost all appetite for food, not only is he dead to all that surrounds him, but this hot and withered body, this dry and pasty mouth, filled with desiccated crusts and sordes, knows no longer even the sense of thirst. This has been the last sense of which he has been deprived. So long as he retained any consciousness at all, he would ask for water or for ice. Now he feels not even

this great want. It is in this crisis of his life that he is to be saved, if saved at all, only by the constant care of his physician, nurse, and relatives. And woe to the physician who can look on such a sight and not yearn to know all that his art has acquired, through centuries of experience and study.

Forty troopers of company A, 10th Cavalry, under the command of Capt. Nolan, had been scouting for some days in the region of "Double Lakes" and "Cedar Lake," looking for Indians. The party left camp after a band of hostile Indians at 1 P.M., of July 26th, 1877. The guide neglected his landmarks, in his anxiety to follow the trail, and was unable to find water when the halt was sounded. The party was compelled, therefore, to make a dry camp, and so pass the night. When they left camp at midday each man's canteen had been filled; but, in consequence of the intense heat, these were emptied in the early part of the march. At dawn of the next day the trail was again taken up and perseveringly followed, not only with a view of capturing the Indians, but also in the hope that it might conduct them to some lake or water-hole. The heat was excessive; "coup de soleil" had prostrated two men, and all were suffering severely from thirst. Towards sunset of this, the second day, the trail began to spread, rendering further pursuit useless, and the chase was given up. Men had been thrown out on the plains all day to seek for water; and for the same purpose the guide explored every

valley and depression within view. Matters were assuming a grave aspect. Many were faint and exhausted ; some fell from their saddles. The horses suffered equally with their riders. Capt. Nolan mounted the guide on his private horse, a tough animal, and ordered him to traverse the country, ranging wherever he thought it possible to find water. The guide was never seen afterwards. Capt. Nolan awaited his return for a time, and then determined to fall back upon "Double Lakes," which were supposed to be 75 or 100 miles distant. There he expected to find water.

They travelled during the night. The next day (the third) they marched in great suffering. "The desire for water now became uncontrollable. The most loathsome fluid would now have been accepted to moisten their swollen tongues, and supply their inward craving. The salivary and mucous fluids had long been absent ; their mouths and throats were so parched that they could not swallow the government hard-bread ; after being masticated it accumulated between the teeth and in the palate, from whence it had to be extracted with the fingers. The same occurred with the mesquite-beans and whatever else they attempted to eat. The sensibility of the lingual and buccal mucous membranes was so much impaired that they could not perceive when anything was in their mouths. The condition of the 'primæ viæ' may in a degree be realized, when it is explained that brown sugar would not dissolve in their mouths, and that it was impossible for them to swallow

it. Vertigo and dimness of vision affected all. They had difficulty in speaking, voices weak and strange-sounding; and they were troubled with deafness, appearing stupid to each other, questions having to be repeated several times before they could be understood; they were also very feeble and had a tottering gait. Many were delirious." Mark, gentlemen, the effect of this lack of water on the mind. "What little sleep they were able to get was disturbed with ever-recurring dreams of banquets, feasts, and similar scenes, in which they were enjoying every kind of dainty food and delicious drink."

At this stage, it is said that "they would in all likelihood have perished had they not resorted to the use of horse-blood." And yet it was only the middle of the third day. "As the animals gave out they cut them open and drank their blood. The horses had been so long deprived of every kind of fluid, that the blood was thick, and coagulated instantly on exposure; nevertheless, at the time, it appeared more delicious than anything they had ever tasted. In fact, every one was so eager to obtain it, that discipline alone prevented them from struggling for more than the stinted share allowable to each. The heart and other viscera were grasped and sucked as if to obtain even the semblance of moisture. At first they could not swallow the clotted blood, but had to hold it in their mouths, moving it to and fro between the teeth until it became somewhat broken up, after which they were enabled to force it down

their parched throats. This horse-blood quickly developed diarrhœa, passing through the bowels almost as soon as taken. Their own urine, which was very scanty and deep-colored, they drank thankfully, first sweetening it with sugar. The inclination to urinate was absent, and micturition performed with difficulty. A few drank the horses' urine, although at times it was caught in cups and given to the animals themselves. They became oppressed with dyspnœa, and a feeling of suffocation, as though the sides of the trachea were adhering; to relieve which they closed the lips and breathed through the nose, prolonging the intervals between each inspiration as much as possible. Gazing on each other, their lips, thus closed, were observed to be covered with a whitish, dry froth, and had a ghastly, pale, lifeless appearance, as though they would never be opened again. Their fingers and the palms of their hands looked shrivelled and pale. Some, who had removed their boots, suffered from swollen feet and legs.

"The situation was now desperate, and feelings akin to despair took possession of them. Suspicious ideas towards each other came over them, and they lost confidence in each other. They again saw the sun set, and another night (the fourth), was spent on these untrodden wastes, without alleviation of their misery. Persistent wakefulness now aggravated their mental anguish, and in vain, at every halt, they lay down and tried to sleep."

Their deplorable condition continued to grow gradually

worse until 5 A.M., July 30th, 1877, when, providentially, part of the command succeeded in making "Double Lakes." This was the middle of the fourth day. They had been out 86 hours, or 3 days and 14 hours, exactly 2 hours over $3\frac{1}{2}$ days, including 4 nights. By this time a number of the men were missing, some having been unable to keep up with the main column, while others had strayed after water.

Both officers and men were almost helpless on reaching "Double Lakes," and the wished-for water did not greatly benefit any of them that day. Canteens of water were at once strapped to the horses, and two or three men sent back on the trail to succor and help on the stragglers. On the following morning, Captain Lee, with some Youkaway scouts, touched at "Double Lakes," and dispatched his scouts on all sides to hunt for men and horses.

It is stated that the "demands of their systems were so imperative that the inclination to drink was irresistible; it seemed impossible to refrain from pouring down water, notwithstanding that their stomachs would not retain it. As they kept filling themselves with water, it was vomited up; the same thing occurred when they endeavored to eat dry food. Warm coffee was the only thing that revived them at all, until after Captain Lee met them."

"Although water was imbibed again and again, even to repletion of the stomach, it did not assuage their insatiable thirst, thus demonstrating that the sense of thirst is, like that of hunger, located in the general system, and that it

could not be relieved until the remote tissues were supplied. Moreover, the activity of this regenerating process was prevented by the deficiency of water in the absorbent vessels themselves. The same-cause is competent to explain the overpowering dyspnœa, which threatened the existence of these men ; for only moist membranes allow the free passage of gases which must take place in respiration. The lungs of these men were filled with the purest air, yet they appreciated an almost overwhelming sense of suffocation. Another point worthy of our attention is the loss these men must have sustained by integumentary and pulmonary exhalations."

Dr. King remarks that the superior endurance of the mule over the horse was obviously manifested on this scout. The horses' tongues were swollen, their mouths and systems affected much in the same manner as the men's ; they could not chew or swallow grass ; many gave out completely. On the other hand, the mules, comparatively unfatigued, would crop the grass and graze at every halt.

On August 1st, Captain Nolan heard that 14 of his followers had managed to get all right as far as the supply camp. His total loss therefore, after this disastrous scout, consisted of two men dead, and two missing, supposed to be dead.

These narratives demonstrate to us not only the suffering and fatality caused by the want of water, but, what is highly important to us as having charge of the sick, the

character of the morbid phenomena induced in the bodily mechanism by this want.

It is impossible to determine what proportion of the frightful mortality on board the raft of the Medusa was the result of the want of water. The soldiers on board the raft were, many of them, from the lowest ranks of society, and when, maddened by danger, and by the wine they had stolen, they attacked their officers and the crew in the middle of the raft, numbers perished from wounds, or were thrown into the sea. On the fourth night, a second combat occurred, which may well be supposed to have been, at least in part, the result of a wild delirium induced by the want of water. Of the whole number on the raft, 147 to 150, only 15 lived to be rescued on the thirteenth day, and of this small number, 5 more died after reaching the port of St. Louis. So that but ten escaped finally. That many of these died from the loss of water there can be no reasonable doubt. They did not die so much of starvation, since they had food, such as it was,—the dead bodies of their companions.

In the case of the soldiers in Texas, the suffering, and the fatality, were solely the result of the deprivation of water, and in this story we read the effects induced in the physiological working of the body by the loss of this aliment. For us one of the most important lessons is the fact that the body begins so soon to feel this loss. At the end of twenty-four hours, two men were already prostrated by sun-stroke, and "all were suffering severely from thirst."

At sunset of the second day, when they had been without water only twenty-four hours (they had water in their canteens during the first hours of the scout), "matters were already assuming a grave aspect; many were faint and exhausted; some fell from their saddles. The horses suffered equally with their riders." Towards the end of the second day, the suffering from thirst was dreadful. The mouth was dry, the salivary and mucous fluids were absent, and solid food could no longer be swallowed. "Vertigo and dimness of vision affected all, and they were troubled with deafness, appearing stupid to each other." They were feeble, and had a tottering gait, and many were delirious. About this time, and at the beginning of the third day, it is stated that "they would in all likelihood have perished had they not resorted to the use of the blood of their horses," and this blood "appeared to them more delicious than anything they had ever tasted." They drank, as did the people on the raft, their "urine thankfully, first sweetening it with sugar," and some drank that of the horses. They "became oppressed with dyspnoea, and a feeling of suffocation as though the sides of the trachea were adhering." The lips, when closed, "were covered with a whitish, dry froth, and had a ghastly, pale, lifeless appearance, as though they would never be opened again." At this time, too, set in the strange delirium which want of water in the blood and tissues induces, a delirium which drives some into a mad gayety, and others to combat and bloodshed.

Another curious effect of this loss, and one important for us to notice, is the irritability of the stomach finally induced by it. When, at last, these unfortunates reached water on the fourth day, such was the change wrought in the organism, that the stomach rejected at first most of the very element necessary for the salvation of life. Water was rejected repeatedly by the act of vomiting, and it was only after repeated draughts, that sufficient was retained to moisten the membranous structures, to such an extent as to enable them to resume their function of absorption. Should the physician, then, refuse his thirsty patient the use of water because it seems to be rejected? It could not all have been rejected by the thirsty soldiers, or they must have perished. Mark also, gentlemen, the sense of suffocation experienced by these men, explained by Dr. King, as the result of the partial desiccation of the membranes of the lungs, which, in this state, were no longer properly competent to the interchange of oxygen and carbonic acid, by the process of transudation.

Let us study, next, from the science of physiology, the uses of water in the economy, in order to obtain a clear idea of the part which this aliment performs. We will ascertain, first, from the observations of the best authors, the average amount of water used by a healthy man. Taking the estimates of Vierordt, Parkes, Dalton, Letheby, and Pavy, I find that the average of the amounts given by these five authors, is 80 ounces in the twenty-four hours. These es-

timates include, you must understand, both the water contained in the so-called solid food, and the free water used as drink. Of course all the water is eliminated, or we should have the extraordinary result of a slow increase in weight, until a man might become as large as an ox, or put on the appearance of a huge jelly-fish. The quantity named is the supply needed by the body under the ordinary conditions of work and external temperature. Under any unusual condition of work or external temperature, the amount required would be much larger.

We find, from physiology, that the body is composed,, according to two high authorities, Dr. Edw. Smith, and Dr. Letheby, of London, of 87 per cent. of water, and, according to Dalton, of 70 per cent. So that it may be said of any man, as About, the witty French author, says of the hero of his story: "*L'Homme à l'oreille cassée*;" that, after all, the colonel was only one-fifth colonel, since he was four-fifths water. All the tissues are composed largely of water. A mummy, which is the body of a man minus water, is a very different thing from a body containing its natural proportion of water.

The blood, that great internal sea, of which scripture says, "For the life of all flesh is the blood thereof," is composed of $15\frac{1}{2}$ pounds of water to $4\frac{1}{2}$ pounds of solid matters. The blood must have a certain degree of fluidity, or how is it to penetrate the myriad channels of the circulation, carrying to all parts of the organism, the precious nutrient ma-

terials which go to renew the tissues, as they are wasted by the processes of life? It goes out from the lungs charged with oxygen. It comes back laden with effete matters and carbonic acid, to be eliminated by the excretory glands and the lungs. How is it to do this great vital work, unless it receive, day by day, the water it requires to maintain its fluidity?

Physiology tells us of another curious and necessary movement of water within the body. It has been calculated that no less than 30 pounds (or pints) of water, ebb and flow from the blood to the alimentary canal each day of our lives. Of this amount the saliva forms 3.5 pounds; the gastric juice, 14.11 pounds; the pancreatic fluid, 8.82 pounds; the bile, 3.54 pounds, and the intestinal mucus 0.47 pound.

The urine eliminates from the body the waste of the nitrogenous tissues, which, if retained, poisons by uræmic intoxication. It varies greatly in amount, according to the quantity of fluids ingested, but averages generally about 45 ounces.

Another most important function of water in the economy, one too little considered by medical men, and not often referred to in works on the practice of medicine, is its office of regulating the temperature of the body, whether the normal temperature as influenced by work and the climate in which we live, or the abnormal temperature which we call fever.

Mr. Thos. Marshall, in his work on Physiology, referring to this function of water, says, p. 510, vol. 2: "It has been

supposed that the living body may possess some special means of resistance to external heat, but of this there is no proof whatever. It may be entirely explained by the effects of evaporation.

“Thus, when the surrounding air is warm or hot, especially if it be dry, the evaporation from the skin is increased, and so the temperature of the body is lowered; whereas, in colder air, especially if this be also moist, the diminished amount of evaporation tends so far to conserve the animal heat. The increased perspiration excited by the great heat of the skin, furnishes, for a certain time, sufficient material for evaporation. There is a limit, however, to the amount of this excretion, and also to the rapidity of evaporation; for when the surrounding air becomes moist, a check being put to the evaporation, the body is no longer thus defended, and its temperature begins to rise.”

He cites the case of a person who remained ten minutes in a dry hot-air-bath at 284° , and also the case of the famous fire-king, Chabert, who went into ovens heated to from 400° to 600° , but for a much shorter time.

Mr. Chas. Brooke, in his work on Natural Philosophy, based on the treatise of Dr. Golding Bird, at p. 797, says: “The abstraction of heat by evaporation is of great importance in the animal economy, as being the principal means by which vital heat is regulated. In the healthy condition of the frame, superfluous heat is carried off, and the temperature of the surface lowered, by a copious evaporation

of fluid, under the well-known form of perspiration, secreted by the wonderful mechanism of the skin, which it would be out of place here to describe. The oppressive feeling of a damp, warm day, and the burning heat of fever, are alike due to the suppression of this natural process; in the former case by the already saturated condition of the atmosphere, and in the latter by the absence of secretion from the skin. The absence of injury from the almost fabulously high temperatures which some individuals are said to have sustained, is entirely due to the same cause, dryness of the air being in these cases an essential condition of immunity; the excessive secretion of fluid to which the skin is stimulated, carries off by evaporation the intense heat, as rapidly as it is imbibed by the surface of the frame."

Y Küss, of the University of Strasburg, in his *Physiology*, translated by Dr. Robt. Amory, says: "The sweat thus secreted by the sudoriferous coil, follows the excretory tube, until it reaches the epidermis, the different layers of which it traverses by means of a tube without any proper walls, which is a hollow in the midst of these layers. As the malpighian layer contains a large quantity of fluid, and the corneous layer, properly so called, is very coherent, these layers derive nothing from the perspiration; but the most superficial layer, the pulverulent furfuraceous or porous corneous layer, collects a large quantity in its interstices. The perspiration, as it reaches this point, resembles a river lost in the sands; nearly all the fluid disappears. Thus if

the skin of a man in good health be touched, it is found to be slightly damp, and produces an indefinable sensation, which is lacking during that period of a fever in which the perspiration is suppressed. It is only in cases where the perspiration is extremely plentiful that it overflows, after being diffused through the pulverulent layer, and appears in small drops in the excretory tubes. In general, however, the perspiration remains in the furfuraceous layers, and thus gives rise to the *moisture* of the skin.

“This humid condition of a superficial porous layer places the skin and the entire organism in a peculiar state: the loss of heat, which is in exact proportion to the abundance of the perspiration, produces constant evaporation. The human body resembles, in this respect, those porous vases, or *alcazaras*, which are used to cool water by means of the evaporation which takes place on their surface: as sudation is generally increased by the elevation of the external temperature, or by any exertion (muscular labor) which has a tendency to produce heat in the body, we possess a means of defence against any too great accumulation of caloric.”

I have made these extracts, especially the latter one from Küss, in order to show the physiological method by which nature acts to diminish the heat of the body.

In order that you may understand the value of the mechanism by which nature reduces the heat of the body, when it is exposed to high external temperature, when overheated by exercise, and in the morbid state called fever, I

must carry you-into the domain of Physics, and I must entreat your close attention and patience. The subject is well worth an effort. Do you recollect the description, in Scott's beautiful romance, *Ivanhoe*, of the tournament in the lists of Ashby-de-la-Zouche? There is a trial of archery between Hubert, a forester in the service of Malvoisin, one of Prince John's knights, and Locksley, the famous Robin Hood. Locksley outshoots Hubert, and, when another trial is to be made, Prince John, who has been offended by one of Robin Hood's free speeches, says to Hubert: "By the light of Heaven, an thou suffer that renegade knave to overcome thee, thou art worthy of the gallows." Hubert had but one set speech for all such occasions. "An your highness were to hang me, a man can but do his best. Nevertheless, my grandsire drew a good bow at Hastings." "The foul fiend on thy grandsire and all his generations," interrupted John. "Shoot, knave! and shoot thy best, or it will be the worse for thee." I do not know that any of my grandsires drew a good bow at Hastings, but I do know that my sire shot many a good bolt at disease; and I propose to shoot, and shoot my best, at these Physics; and can only hope that my bolt may reach the centre of your intelligence.

I can best give a correct idea of the value of the evaporation from the skin and lungs, by stating the amount of heat absorbed by water during evaporation. When I cite the facts upon this point as they are given in the late works on Physics, you will be surprised at the figures I shall present.

I begin by the use of two scientific terms, the precise meaning of which you must grasp before you can understand this matter properly. These terms are the heat-unit or thermal unit, the measure of heat, and the foot-pound, the measure of work. The heat-unit, adopted by Ganot in his work on Physics, is the amount of heat necessary to raise a pound (or pint) of water through one degree of the Centigrade thermometer. The foot-pound, or measure of work, is the force converted into energy, necessary to raise a pound weight one foot in height. Following the researches of Meyer, Joule, Helmholtz and other scientists, Ganot states that the quantity of heat necessary to raise a pound of water through 1° Centigrade, represents a force which, if converted with actual energy, will raise a weight of 1392 pounds one foot in height, or one pound 1392 feet in height, or, in other words, one thermal unit converted into actual energy, will accomplish 1392 foot-pounds of work.

I hope you begin to see how beautifully these modern discoveries explain to us the manner in which nature deals in the wonderful mechanism of the human body. Ganot says (p. 292) that the "heat necessary to raise one pound of water from zero (Centigrade thermometer, or 32° F.) and convert it into steam at 100° (Centigrade, or 212° F.), represents a mechanical work of 885,430 units, which would be sufficient to raise a ton weight through a height of nearly 400 feet." Taking his formula (which is derived from Regnault) of the total amount of heat necessary for the

evaporation of water, I find that the evaporation of 36 ounces (the average amount evaporated from the skin and lungs of a healthy man in 24 hours) represents a force which, if converted into actual energy, would produce 1,936,880 foot-pounds of work. These figures are so large that I should hesitate to place them before you, did they not so nearly correspond with those given by Ganot, to wit, that the heat necessary to carry a pound of water from the freezing-point of Fahrenheit to full evaporation "represents a mechanical work of 885,430 units."

Let us see what the amount of work above stated is capable of doing when turned into what is called horse-power. An engine is said to be of one-horse power when it will raise 33,000 pounds one foot high in a minute, this being the average rate of work of the strongest London horses (Balfour Stewart on Heat, p. 346). It appears that the 1,936,880 foot-pounds of work reduced to horse-power would be equal to one-twenty-fourth of the work of a one-horse engine, working continuously through twenty-four hours.

These calculations show us the amount of heat required for the vaporization of the water of the lungs and skin, in ordinary health. A scientific friend, to whom I referred them, expresses a doubt whether some of the heat necessary for the vaporization of the cutaneous perspiration is not supplied by the surrounding atmosphere. He thinks there can be no doubt that the heat employed in the evaporation from the lungs, must come wholly from the body. I feel

very incompetent to give an opinion on this point, and yet it seems to me that, so long as the body is above the temperature of the air, and especially when its heat rises to 101° , 103° , and 104° , or higher, as it does in fever, the air, at a much lower temperature, can have but small agency, if any, in the supply of heat for evaporation.

After determining the quantity of water required by the healthy man, and the measure of heat abstracted from the body in the process of regulating its temperature by evaporation, it becomes proper to find a standard, if we may, of the amount required in diseases attended by abnormal elevation of the bodily temperature.

With this view I have had the amount of fluid consumed in twenty-four hours, in four cases of febrile disease, measured as accurately as I could have it done. One of these cases occurred in my private practice, and three in the wards of this hospital. The first was a case of very mild typhoid fever, in a woman sixty years of age. She belonged to the easy class of society, was a healthy, active person, and of very moderate habits as to eating and drinking. The liquid food she took was carefully measured. I am sorry to say that the free water used was not so accurately measured, but was estimated by a competent nurse, from the size and number of glasses of water she was supposed to take. I saw this patient first at her country-seat, about the 9th, or 10th day of the disease, October 17, 1878. She was brought to town the next day in a carriage, and I saw her daily. The

highest temperature observed was on the evening of the eighth day, 102° . On the following day the temperature was $101\frac{1}{2}^{\circ}$. On the evening of the sixteenth day it was $100\frac{1}{2}^{\circ}$, and, by the 19th day, had fallen to 99° . The temperature, after this, varied from $97\frac{1}{2}^{\circ}$ in the morning, to 99° in the evening, except on three occasions, when it marked $99\frac{1}{2}^{\circ}$ to $99\frac{3}{8}^{\circ}$. On the thirty-fifth day convalescence was fully established. During all this time the bowels were torpid, being opened every alternate day by a small warm water enema. There was at no time any delirium, tremor, or considerable exhaustion. There was slight drowsiness, but the patient was perfectly intelligent throughout. There can be no doubt about the diagnosis, as the typhoid eruption was well marked, and the duration of the case, the tympany, and the absence of any local cause of illness, permitted no other explanation.

The observations in this case were made by the son of the patient, an accurate and well-trained physician, and by a very competent nurse. They were commenced on the 19th October, the eleventh day of the fever, and were continued through twenty-one days. During this time, the daily average of liquid food consisted of 21 ounces of milk, and 11 ounces of beef tea. About 20 ounces of free water, and a little over 3 ounces of brandy, were taken each day, making in all 55 ounces of fluid for each day. The bowels were, as I have said, torpid; the urine was something less than the full normal amount, and there were no sweats, so

that if we suppose thirty ounces of fluid to have run off by the kidneys, we have, as the loss by insensible perspiration from the lungs and skin 25 ounces per day. The patient recovered.

The three cases observed in the hospital were under the charge of the very competent resident physician, Dr. Henry M. Wetherill. The nurse was told to see that the patients should have, in addition to their liquid aliment, all the free water they desired. The water was not to be pressed upon them, but it was to be offered frequently, and they were to have all their thirst demanded, and all they might take with pleasure and satisfaction. One of these cases was an acute tuberculosis of the lungs, of which the patient died, and the diagnosis was determined by a post-mortem examination. The other two were cases of typhoid fever, both of which recovered.

The patient with acute tuberculosis was a male, 29 years of age. The temperature in the axilla varied from 100° to $104\frac{1}{2}^{\circ}$. It was seldom below 101° . He took very regularly, three pints of milk, one pint of light beef tea, and from 60 to 84 ounces of free water in each twenty-four hours. The average daily supply of fluid taken with comfort and ease was therefore 114 ounces. During this time he had no diarrhoea, and voided only the usual amount of urine. He therefore got rid, each day, of 69 ounces of water over the full normal amount of urine, 45 ounces. This must have been eliminated by the insensible perspiration of the lungs

and skin, as he had no considerable sweats. That the skin was acting all the time, though it felt hot and dry to the hand, was proved by the simple experiment of pressing upon it, for a few moments, a good Stanhope lens. The lens always showed, distinctly, minute drops of watery fluid upon it. Can there be any reasonable doubt that the large supplies of water, dictated by the man's excessive thirst, were being used by nature to cool the body by evaporation?

In one of the typhoid fever cases the observations were continued 18 days. From October 4th to the 17th, inclusive, the evening temperature in the axilla varied from 101° to $103\frac{1}{2}^{\circ}$ with one exception, when it fell to 100° . During these 14 days, the average daily ingestion of free water was 60 ounces. From October 18th, to the 21st, inclusive, the evening temperature varied from 98° to 101° , and the average daily ingestion of water was 30 ounces. Throughout the 18 days, he took, each day, four pints of milk and one of beef tea, making the total average of fluid 133 ounces, or 8 pints and 5 ounces.

In the second case the observations were made from September 30th to October 20th, inclusive—21 days. The evening temperature in the axilla varied usually between 101° and $102\frac{1}{2}^{\circ}$. On two occasions it fell to $100\frac{1}{2}^{\circ}$. The average daily amount of free water was 53 ounces. Adding to this, four pints of milk and one of beef tea, gives the total daily average of fluid as 133 ounces, the same precisely as in the first case.

The second case was less severe, in some respects, than the first, though it was more prolonged. There was no material hebetude, and no tremor, whilst in the first there was considerable hebetude, and, in the early days, a great deal of tremor. It is a curious fact, and one worth remarking, that the average amount of fluid used was exactly the same in the two cases. The two patients were nursed in the same way. They were given exactly the quantity of fluid they desired, and no more.

In the two typhoid fever cases there was considerable diarrhœa, so that it is impossible to determine what proportion of the large amount of fluid taken was eliminated by the skin and lungs.

Applying to the case of acute tuberculosis the calculations employed for a man in health, we find that the heat necessary for evaporation from the skin and lungs, of the 69 ounces of water he lost in this way, would, if converted into actual energy, give 3,708,288 units of work, or foot-pounds. This sum represents about one-twelfth of the work of a one-horse engine, working continuously through twenty-four hours.

It is interesting to observe how different were the amounts of liquid food and water, used by the patient with typhoid fever in private practice, as compared with those consumed by the two hospital cases. The difference was due in part, I suppose, to the habits of the classes of society to which the patients belonged. Laborers use habitually

larger amounts of food than members of the easy classes. The principal cause of the difference, however, was the unusual mildness of the private case. She was living a life of absolute idleness, with no acute symptoms, and therefore with very little waste of the tissues. Dr. Letheby, in the work above cited, states that the quantity of food required in a state of absolute idleness in a day, is very little more than half that which is necessary in ordinary labor, and considerably less than half that required in active labor.

These cases show, moreover, very clearly, the proportion which thirst bears to the heat of the body, for the water taken in the mild case was very moderate in amount. In those observed in the hospital, on the contrary, the thirst was incessant, and the water taken large. The supply of food, also, was much greater in the severe cases, as the waste of the body, by internal combustion, was excessive.

To give you a striking picture of the importance of this supply of both food and water in fever, I will quote a passage from an admirable discourse before the British Medical Association at Oxford, by the Rev. Prof. Samuel Haughton, of Dublin, in the Divinity School, August 6th, 1868. The title of the discourse is the "Application of Physics to Medicine in Modern Times." It was published, with other addresses, in London in 1869.

Professor Haughton, speaking of Typhus Fever, says: "Your patient lies before you nine or ten days, supine, fasting, subdelirious; the picture of weakness and helpless-

ness; and yet this unhappy sufferer actually performs, day by day, an amount of work that might well be envied by the strongest laborer in our land." "We have seen," he goes on to say, "that the work due to Animal Heat would lift the body through a vertical height of six miles per day; and it thus appears that an additional amount of work, equivalent to the body lifted through nearly one mile per day, is spent in maintaining the temperature at Fever heat.

"If you could place your patient at the bottom of a mine, twice the depth of the deepest mine in the Duchy of Cornwall, and compel the wretched sufferer to climb its ladders into open air, you would subject him to less torture, from muscular exertion, than that which he undergoes at the hand of nature, as he lies before you helpless, tossing, and delirious, on his fever-couch." He advocates strongly the practice of "retarding the disintegration of the tissues consumed to supply the fever heat, by furnishing in their stead, fuel in the form of wine and beef tea, sufficient to maintain the increase of temperature imperiously required."

Before passing to the fourth and last division of my subject, the establishment of some fixed rule of practice as to the amount of water that ought to be furnished the sick, I desire to say a few words on a point which I think may have an important practical bearing. To look at some cases of desperate illness, especially some of the low fevers, it might seem that a body so changed from its normal physiological status could no longer be obedient to the laws of

the healthy body. When a patient lies insensible and comatose, without sense or appetite, an inexperienced or thoughtless person might be influenced, unconsciously, to some carelessness in the administration of aliment or water, to so inanimate a machine. But the body continues, as before, its destructive assimilation, and still burns off its tissues and fluids. That this is true is proved by the phenomena of inanition. Chossat and Collard de Martigny starved different animals, in order to observe the process of death. The animals lost weight rapidly, and died usually when they had lost four-tenths of their original weight. A few survived until they had lost five-tenths of weight. The blood was found, in these experiments, to be diminished about three-quarters, and the digestive system one-half. Dr. A. Flint, Jr., states that "one of the most marked and important changes in inanition, is diminution in quantity and impoverishment of the blood. Collard de Martigny observed the quantity of blood to undergo diminution to such an extent, that the skin and some of the muscles, when incised, discharged no blood, but only a little serum, sometimes colorless, and sometimes slightly rose-colored. He is of opinion that during the latter periods of inanition, many of the tissues receive no blood." You will recall the fact, that of the soldiers deprived of water in Texas, though with abundance of food, two died in less than four days, and that two were missing, and had probably died.

It is our duty, therefore, no matter how low may be the

condition of the patient, to supply him with, at least liquids, and fluid aliment. Though we are told, as I have been, "trouble the sufferer no more," we must persevere to the very end. What harm can it do to moisten the dry lips and mouth with milk-punch, wine-whey, or brandy-water? And to see but a few patients, or one only, in a long life, thus rescued from the very jaws of death, what a triumph and consolation!

What then is to be the guide as to the quantity of water to be supplied to the sick? I answer, unhesitatingly, that, so long as the patient retains his natural senses or appetites, there is no guide so sure, and so safe, as the thirst. When this is lost, the trained knowledge of the physician, or the common-sense and experience of the nurse, must determine the quantities that should be given. What is this thirst upon which I rely so implicitly? It is the appetite implanted in the body by the Creator, for the determination of the amount of water needed. The infinite wisdom which made the eye, the ear, the mind, the soul, established also the appetites of thirst and hunger, by which to regulate the amounts of food and liquid necessary for the sustenance of the animal. These senses are quite as wonderful and unerring as the instinct of the bee to make its mathematical cell, or to suck honey from the flowers; of the ant to lay up store of food for its young; and of the migratory bird to seek its nutriment in new climates. For myself, I dare not oppose this divine sense in a thirsty patient, any more than I would oppose

the instinct of the infant to take from its mother's breast the material it needs for its growth.

One of the ablest writers of the present century on Mental Philosophy, Mr. Alex. Bain, Professor of Logic and Mental Philosophy in the University of Aberdeen, says that "the only account of mind strictly admissible in scientific psychology, consists in specifying three properties or functions,—Feeling, Will or Volition, and Intellect; through which our experience, as well objective as subjective, is built up." Feeling, he says, includes all our pleasures and pains, and certain modes of excitement, or of consciousness simply. He distinguishes between appetite and instinct. The appetites are a select class of sensations; they may be defined as the uneasy feelings produced by the recurring wants of the organic system. "The commonly recognized appetites grow out of the recurring wants of the organic system; they are Sleep, Exercise, Repose, Thirst, Hunger, Sex." The cravings of thirst, inanition, hunger, show the twofold operation of appetite,—“the massive uneasiness of privation, and the equally massive pleasure of gratification, whose combined motive power makes the strength of the volition or appetite.” Instinct, he says, is defined as untaught ability. It is the name given to what can be done prior to experience or education; as sucking in the child, walking on all-fours of the newly-dropped calf, pecking by the bird just emerged from its shell, the maternal attentions of animals generally.

Thirst does not mean that the mouth, or throat, or stomach, merely want water poured over or into them, but that the hand, the foot, the brain, the body and all its members, need water. The thirst corresponds, Carpenter says, "to the excess of demand in the system over the supply afforded by the blood, and it is caused to abate by the introduction of the requisite material into the circulating fluid, even though this is not accomplished in the usual manner, by the ingestion of food or drink into the stomach."

Do you recollect the famous speech against Cæsar which Shakespeare makes Cassius utter?

"He had a fever when he was in Spain,
And, when the fit was on him, I did mark
How he did shake: 'tis true, this god did shake:
His coward lips did from their color fly;
And that same eye whose bend doth awe the world
Did lose his lustre: I did hear him groan:
Ay, and that tongue of his that bade the Romans
Mark him, and write his speeches in their books,
Alas! it cried, *Give me some drink, Titinius,*
As a sick girl. Ye gods, it doth amaze me,
A man of such a feeble temper should
So get the start of the majestic world,
And bear the palm alone."

This is very fine invective, but the great poet of human nature paints only the truth, when he shows us one of the most daring soldiers of all time, trembling with fever, and begging for water to quench his burning thirst.

What is to be our guide as to the amounts of fluid food, and free water, when the patient falls into insensibility, and we have no longer the sense of thirst to assist us? We must, in this event, trust to our scientific knowledge of the needs of the body. We have ascertained that a healthy man requires, in a condition of ordinary activity, about 80 ounces of water, including that contained in the solid food, and in the water used as drink. The patients observed in the hospital with high temperatures, took daily, and assimilated with ease and comfort, from 114 to 133 ounces of fluid, measuring the liquid food and the free water. Does the patient require less because he is insensible, and incapable of feeling or expression?

One simple and proper rule would be to continue the amount he was taking before he fell into insensibility. The temperature of the body will furnish another excellent criterion. So long as the heat rises to 102° , 103° , or 104° , and when the skin is dry as well as hot, the tongue and mouth pasty and desiccated, it would be proper to aim at administering in each twenty-four hours, two or three pints of milk and one of beef-tea. If he can be made to swallow four ounces of milk or beef-tea every two hours, he would get forty-eight ounces, or three pints of fluid, in this time. If, besides this, four ounces of water can be administered every two hours, he would gain an additional forty-eight ounces, or ninety-six in all. It may seem rough work to be dosing an insensible man, with food or drink, every hour, through

all the weary days and nights. But, the life of a man in this condition has become so much that of a vegetable, that this practice does not disturb him as much as one might suppose. This stupor is not sleep, and I know, from experience, that such a patient may often be made to swallow thin liquids without any great disturbance. At all events, we are compelled to stand to him in the place of his lost faculties, and it is well known that these conditions are often recovered from in the low fevers. It is surprising how rapidly fluids are absorbed in illness. Dr. Beaumont states, from his observations on Alexis St. Martin, that "in the febrile diathesis or predisposition, the villous coat of the stomach becomes sometimes red and dry, at other times pale and moist, and the secretions become vitiated, and greatly diminished or suppressed." When these appearances were considerable, "and particularly when there are corresponding symptoms of disease, as dryness of the mouth, thirst, accelerated pulse, etc., *no gastric juice can be extracted, not even on the application of alimentary stimulus.* Drinks received are immediately absorbed, or otherwise disposed of, none remaining in the stomach ten minutes after being swallowed. Food (solid food is referred to) taken in this condition of the stomach, remains undigested for twenty-four or forty-eight hours or more, increasing the derangement of the whole alimentary canal, and aggravating the general symptoms of the disease."

In the condition of insensibility under consideration,

stimulus is almost always necessary, and the proper quantity may be given either with milk or free water. In some such cases, when difficulty of swallowing, or automatic resistance on the part of the patient, prevents the administration of the proper amount of liquid food and water, I have used injections of water, or of beef-tea and water. When severe diarrhœa is present, this cannot be done; but when there is no diarrhœa, or when this is slight, four ounces of water or beef-tea, with or without a little brandy, thrown into the rectum every six hours, would give an additional supply of from sixteen to twenty-four ounces of fluid, or about the same amount as that taken in the two cases of typhoid fever observed in the hospital.

I am acquainted with the details of a case which occurred in this city, some twenty years since, which shows the value of perseverance in details. A child, a girl, of five or six years of age, had an attack of convulsions, which lasted several days, and ended in complete insensibility. At last the patient seemed to be moribund. The consulting physician was so convinced that the patient was dying, that he refused at the evening visit, to return next day. To relieve the anxiety of the family, a young physician was requested to remain in the house, to watch by the bedside. He told me that he passed the night dropping in between the half-closed lips, teaspoonfuls of weak brandy and water. Towards morning, some signs of rallying appeared, and the child finally recovered, and lived to be a married woman.

WATER.

In another case I was called in consultation to see a boy five years of age, with typhoid fever. The child was one of those characters in which a sensitive temperament was combined with an unusually strong will. He disliked both milk and beef tea, and refused them so persistently that he fell into a dangerous exhaustion. Finally, I told the father, who was a physician, that it was absolutely necessary to administer two or three tablespoonfuls of milk punch or beef tea every hour. The father, happily, thought of the little modern invention called a dropper, consisting of a tube of glass, with a small india rubber bulb attached to one end. He found that, with this little instrument, he could drop fluid into the mouth without disturbing the child from its drowsy stupor. It succeeded so well, that all the liquid food and water necessary were administered in this mode for several days, and the patient soon began to improve and recovered. It was a very happy inspiration, and may, some of these days, be used by some of you with equal success.

There is another point in practice in regard to the use of water for the sick, which will surely occur to you, before you shall have been long in your profession. When the stomach is irritable, so that vomiting occurs after the ingestion of liquids, and in cases of diarrhoea or dysentery, are we to deny water because its use is followed by vomiting, or because the bowels are opened frequently? I think not. So long as there is acute thirst I believe that water ought

to be given. It may be well to try ice from time to time, but severe thirst is never, so far as I know, slaked by the slow process of melting ice in the mouth. The amount of water obtained in this way is not sufficient. I am in the habit, in such cases, of giving water in moderate doses at frequent intervals. Even though most of it be rejected, some is absorbed, and, after a time, the irritability of the stomach usually diminishes. This is especially true of children suffering from cholera infantum, diarrhœa, and indigestion, who will reject, time and again, for some hours or a day or two, milk, beef or chicken tea, and yet, after a while, begin to retain cool or iced water. The addition of a little brandy, a teaspoonful to a pint or half pint of water, will, for some reason it is difficult to explain, enable the stomach to retain this mixture, when free water is rejected. At all events it is wise to make frequent and numerous trials with water, especially so long as the patient craves, and takes eagerly, this simple aliment.

You will remember the condition of the soldiers in Texas, when they first reached water on their return march. They drank eagerly and largely of water, and yet rejected it for hours by vomiting. It could not all, however, have been rejected, for gradually, the tissues of the body became once more moistened by imbibition, and as the organism resumed its normal functions, the vomiting ceased. As I said before, in my comment upon this interesting observation, a physician would scarcely have denied to these thirsty men, the water they craved, because they vomited.

In a foot-note to the article on cholera by Dr. William Aitken, in his *Science and Practice of Medicine*, London, 1860, Vol. 1, p. 663, you will find a note from Prof. Maclean, of the Royal College at Netley, near London. Prof. Maclean was, for some time, one of the deputy-inspectors of the British Army in India, where he had seen cholera in its native home. He says: "Urgent thirst is one of the most distressing symptoms of cholera; there is incessant craving for water, doubtless instinctive, to correct the inspissated condition of the blood, due to the rapid escape of the *liquor sanguinis*. It was formerly the practice to withhold water—a practice as cruel as it is mischievous. Water in abundance, pure and cold, should be given to the patient, and he should be encouraged to drink it, even should a large portion of it be rejected by the stomach; and when purging has ceased, some may, with much advantage, be thrown into the bowel from time to time."

Dr. Thos. King Chambers, of London, one of the best medical writers of the day on the stomach, and on the indigestions, in an article on dietetics, in the last edition of the *Encyclopædia Britannica*, remarks that patients with fever should take no food but liquid food, and adds, in his pithy way, that water is the most digestible of all foods. I beg you to observe that small quantities of a fluid, often repeated, soon run up into a considerable bulk. "Many littles make a mickle." A large wineglassful (two ounces) of fluid, given every five minutes, will give the sick man or child, twenty-

four ounces or a pint and a half in the space of an hour. When the body is desiccated by fever, or by the loss of its fluids, through numerous evacuations from the bowels or skin, or by vomiting, there is no drug to take the place of the only created thing, which can give back to the tissues and blood, the water they plead for by the appointed appetite, thirst.

And now, gentlemen, I bring these lengthy remarks to a close. I fear they have tried both your patience and attention, but I venture to hope that, in some future day, when you get into the whirl of practice, they may assist you in what is to be the object of your lives,—the cure of the sick.

Let me quote a text from Scripture to you. You know what was said to the Pharisees of old: "But woe unto you Pharisees! for ye tithe mint and rue and all manner of herbs, and pass over judgment and the love of God: those ought ye to have done and not leave undone." Let us beware lest it be said to us: "But woe unto you, doctors! for ye order pills and potions, and all manner of drugs, and pass over water, and so fail in judgment, and true love of your patients."

